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SOME OBSERVATIONS ON ACUTE ASCENDING PARALYSIS.*†

PETER BASSOE,
Instructor in Pathology, Rush Medical College, Chicago.

THERE is no need of reviewing the literature of the so-called Landry's paralysis, as that has recently been done by Gordinier[1] and Mettler[2] in this country and Buzzard[3] in England. However, there are some articles too recent to have been reviewed by them. Rolly[4] reports seven cases observed in the medical clinic of Leipzig in the course of the last 15 years and concludes that Landry's paralysis is not a clinical entity but a symptom complex occurring in certain cases of acute polyneuritis, and that cord changes, when they occur, are due to an ascending neuritis reaching the cord. That such a view is untenable has already been pointed out by Mönckeberg[5] who reported the case of a girl of 12 years with typical clinical course and the post-mortem findings of an intense acute poliomyelitis with hemorrhages, while the changes in the peripheral nerves were purely degenerative and readily explained by the destruction of many ventral horn cells. The frequent positive bacteriologic findings, and particularly the finding by Buzzard in such a case, of a diplococcus producing paralysis in rabbits will undoubtedly cause more stress to be laid by future observers on thorough bacteriologic examination and experiments on animals. Babonneix[6] produced an ascending paralysis in dogs by injecting intravenously either the attenuated cultures or toxines of diphtheria and found necrotic foci and diffuse cell changes in the cord and disseminated peripheral neuritis, in one case also fatty degeneration of the muscles. He concludes that the diphtheritic experimental paralysis always presents the same evolution

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[1] *Albany Med. Annals*, 1904, 25, p. 56.

[2] *Jour. Am. Med. Assn.*, 1904, 42, p. 1267.

[3] *Brain*, 1903, 26, p. 94.

[4] *Mün. Med. Wchnschr.*, 1903, 50, p. 1283.

[5] *Ibid.*, p. 1958.

[6] *Archives gén. de Méd.*, 2, 1903, p. 3201.

and the clinical picture of acute ascending paralysis as described by Landry, and that it seems to be attributable to central lesions.*

Through the courtesy of Dr. Barber, recently of the Cook County Hospital, and of Dr. Le Count, pathologist to this hospital, I was privileged to attend the autopsy and secure material for histologic examination in the following case.

CLINICAL HISTORY.

The patient, an American roofer, aged 24 years, was admitted to the Cook County Hospital, September 8, 1903. He was sent in by Dr. D. F. Grasse, who kindly gave the facts of the previous history of the patient and also aided in securing the autopsy.

The patient had the usual diseases of childhood. Gonorrhea at 17.

Present illness.—The onset was gradual. September 2, he complained of headache and some backache, was better the following morning, but worse in the afternoon. He continued to work until the afternoon of September 5, when he became dizzy and was afraid he would fall off the roof. There was severe pain, mainly in the abdomen. He took hot whiskey before going to bed, and perspired profusely, but could not sleep on account of pain, and walked the floor all night. September 6, he first bought a porous plaster, then went out to see a physician. He slept two hours during the night. There had been severe pains in the legs all day. The following morning, September 7, the pain ceased in the left leg, which became totally paralyzed. The pain diminished in the right leg, which became paralyzed early in the morning of September 8. On this day he was admitted to the hospital. The arms began to become stiff and weaker, the right more so than the left. The muscles of the neck also became weaker. Urinary retention commenced September 7, necessitating the use of a catheter. The bowels had been regular. The appetite was lost.

Physical examination on admission September 8.—Young man, medium stature, fairly well developed. Lies quietly in bed. Cannot move lower extremities at all. Pulse of good volume and regular.

Sclerotics slightly congested. Pupils small, but equal, and react normally. Ocular movements normal.

Tongue thickly covered with yellowish-white coat. The chest is long and deep; symmetrical; sternum slightly retracted. Pectoral muscles prominent. Breathing almost entirely diaphragmatic.

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*Just as this article is going to the press one by SCHMAUS (*Ziegl. Beitr.*, 1905, 37, p. 411) has appeared in which he reports a case with the clinical picture of Landry's paralysis, beginning with disturbance of the muscles of respiration. The autopsy revealed a severe infiltrative and hemorrhagic myelitis with extensive destruction of the ganglion cells; the medulla oblongata was also involved. The trunks of the peripheral nerves were normal, so Schmaus excludes the possibility of a primary neuritis. The colon bacillus was obtained from the blood, spinal cord, tonsil, and a cervical lymph node. A few streptococcus colonies were obtained from the tonsil and spinal cord. Schmaus regards the case as one of infectious, or toxic-infectious, myelitis, and bulbar myelitis which followed a comparatively mild angina, and adds that he knows of only one other case of Landry's paralysis following an angina, namely one reported by Hochhaus.

Pulmonary resonance good throughout.

On taking a deep breath, the abdomen becomes markedly prominent, with but slight motion of the chest walls, and on expiration there seems to be a sudden jerk in the movement of the diaphragm.

Heart dulness, vertically, from third to sixth rib. Laterally, mid-sternal line to just within nipple line. Apex beat in normal position. Sounds clear.

Splenic dulness extends to ninth rib in posterior axillary line. Spleen is not palpable.

Upper border of liver is at fifth interspace in nipple line. Lower border of dulness 3 cm. above costal arch. Not palpable.

No distention of abdomen. Breathing almost entirely abdominal.

Phimosis present. Discharge of thick, yellow, purulent material from urethra.

Sensation is entirely normal. Patient can tell what portion of the body is touched, and whether it is a prick or a touch. Heat and cold are distinguished without hesitation at any point of the lower extremities. In the upper extremities sensation is unimpaired. Movements are possible but quite feeble, more marked in left arm. The extensors are more involved than the flexors. Pronation and supination are of about equal strength. The hand grasp is very weak, slightly more marked on the right side.

Muscles of neck very weak. He cannot lift his head from the pillow.

The lower extremities lie entirely helpless. Motion entirely lost, but on close inspection a slight twitching of some of the muscles can be seen, most prominent in the left gastrocnemius.

Reflexes.—On stroking the bottom of the left foot a slight response is elicited, the great toe being slightly extended. All other reflexes in the lower extremities are lost. The scrotal and abdominal reflexes are also lost. The left pectoral muscles and the muscles of the neck, especially the trapezius, still respond slightly. Of the scapular muscles the supraspinatus has the most marked reaction. The corneal pharyngeal reflexes are intact. The patient can no longer control the sphincter of the rectum and is unable to bear down.

On admission the temperature was 101°, pulse 112, respiration 28.

At 5 P. M., on the same day the following note was made: The patient cannot use the right deltoid, and cannot rotate the right arm. Rotation of right forearm is almost entirely absent. Flexion of right hand good, extension imperfect, especially of little finger. Flexion and extension of forearm weak and incomplete, and as there is no rotation of the upper arm, the forearm drags over the chest. The arm cannot be abducted and adduction is extremely imperfect. The left arm can be partially abducted, and completely adducted and rotated. Flexion and extension of hand and fingers is good.

The posterior cervical muscles are somewhat hypertonic. The trapezius works normally.

In the evening a permanent catheter was inserted, and at 10 P. M. the following record was made:

The right arm cannot be raised. The fingers can be moved. The grip is very slight. The left arm can be raised. The grip is getting much weaker. On deep inspiration the diaphragm is quite jerky. The abdomen is quite distended. He complains of nasal obstruction.

During the night there is a record of profuse perspiration, and of difficult breathing due to nasal obstruction. The urine collected to the amount of 600 c.c. There was no bowel movement.

During the next day, September 9, the arms are recorded as growing weaker, and the fingers of the right hand as being numb. The urinalysis was as follows: yellow; acid; sp. gr. 1022; no albumin, sugar, or casts; pus present.

Blood examination: reds 5,660,000, leucocytes 13,000, hemoglobin 95 per cent.

At 5 P. M. the following note was made:

"The left hand, wrist, and fingers can be flexed and extended, except the little finger. The right hand cannot be extended at all, but can be flexed. The arms and shoulders cannot be moved on either side.

There is pain in the chest on taking a deep breath. During the 24 hours from admission, the pulse rate has been between 80 and 100, the temperature between 100° and 101.2°, and the respirations 28 to 42."

On the morning of the 10th he felt better, but breathing seemed more difficult. Six hundred c.c. of urine had collected; no bowel movements. At noon Dr. Barber made the following record: "Less motion in left hand and fingers. On the right side there is no extension, but slight flexion is still possible. Sensation slightly dulled on trunk and lower limbs. Left leg stiff."

At 4 P. M.:

"Motion of hands almost entirely gone. Only a slight flexion of left fingers remains. The eyes are rolled up. The patient is still rational and can talk."

During the second 24 hours, the pulse rate was 80-100, temperature 99.8°-100.4°, respirations 22-36.

At 4 P. M. on the 10th, a lumbar puncture was made and 10 c.c. of slightly turbid fluid removed. Cultures were made in broth, and smears were stained. All were totally negative. Differential blood count of 250 cells was as follows:

Polymorphonuclear	86%
Small Mononuclear	5.6%
Large Mononuclear	4.8%
Transitional	3.6%

A note is made at 6 P. M. of the patient's talking irrationally, the first record of this kind in the history.

On the morning of the 11th the record is: "Patient cannot move any part of the upper extremities. Breathing is somewhat labored."

During the third 24 hours, 950 c.c. of urine were collected. Pulse was 96-120, temperature 99°-100.2°, respiration 22-32. Several records of a delirious condition were made. On the 12th, after four days without a bowel movement, vigorous purgation was instituted, with no effect till the morning of the 13th, when a large bowel-movement was brought away by an enema. During the fourth 24 hours, 800 c.c. of urine were collected. The temperature was 100°-101°, pulse 112-132, respiration 26-28. During the fifth 24 hours, 400 c.c. of urine were collected, pulse 120-136, temperature 100.6°-103.4°, the rise beginning at midnight on the 12th. The mental condition remained about the same.

From this time to the end, the temperature gradually increased, from 103.6°-106.2°-106.8°-108.8°, the latter being taken 20 minutes before death. The pulse increased gradually to 160, and the respirations to 44. Vomiting occurred on the morning of the 14th. During the last 10 or 12 hours, there was a profuse perspiration, and shortly before death a sudaminal eruption appeared. Death occurred on the 14th at 11:50 A. M.

AUTOPSY.

The autopsy was held three hours after death by Dr. Barber.

The body is that of a well-nourished young man 160 cm. in length. Rigor is extreme; lividity marked behind, and slight in front. The body is still slightly warm. There is a small bed-sore over the sacrum, and a beginning bed-sore over the left scapula. There is a needle wound on the right side, opposite the spinous process of the second lumbar vertebrate. There is slight miliary eruption on the back, shoulders, and neck. A catheter found in the urethra is removed with difficulty on account of a thick coating of crystals.

The abdomen is distended. On cutting through the abdominal wall it is noticed that the blood is very black. The omentum is thin and free, coming within three inches of the pubes. The small intestines are greatly distended. The sigmoid contains scybala. The contents of the small intestines are fluid. The cecum is well in the pelvis; the appendix is parallel to the pelvic brim and free. There are no adhesions about the spleen, liver, or gall-bladder, and no fluid in the peritoneal cavity.

The pleural cavities are empty, and there are no adhesions except over the right apex.

The pericardial cavity contains a small amount of clear fluid; there is a white fibrinous patch on the anterior surface of the heart.

The tongue is coated.

The thyroid is normal.

The larynx and trachea are full of frothy mucus.

The esophagus is normal.

The lungs are dark and less crepitant than normal, especially in the lower lobes. Both lungs float. The right lung weighs 350 grams. There are some torn adhesions over the apex and dark patches posteriorly over the upper lobe. There are some fibrous adhesions in the inter-lobar clefts. Otherwise there is nothing abnormal. The cut section presents a normal appearance except for the presence of fluid in the lower lobe. The left lung weighs 330 grams. The appearance is the same as the right, except for a few emphysematous patches anteriorly.

The heart weighs 315 grams. It is firm to the touch and the apex consists entirely of the left ventricle. There is a sheet of white fibrin on the anterior surface easily removed, leaving a smooth surface and ecchymotic spots under the pericardium. The mitral leaflets are slightly sclerotic; all other valves are normal. The myocardium is dark and firm. There is a white clot in the right auricle, and some white clots adhering to the tricuspid leaflets. Otherwise the heart is normal.

The aorta shows a few sclerotic patches.

The spleen is small, weighing 95 grams. The color is dark red, the consistency slightly increased; otherwise there is no change.

The left kidney weighs 165 grams. It is angular in contour; the capsule strips readily, leaving a smooth surface with prominent stellate veins. The cut surface is dark and bloody. The relation of the cortex to the medulla is as 1 to 3. The mucous membrane of the pelvis is smooth, showing slight congestion of the veins.

The right kidney weighs 115 grams. The capsule is adherent to part of the upper pole. Otherwise it resembles the right kidney.

The ureters show no change.

The bladder contains turbid urine and there is marked congestion of the trigone.

The testicles are normal, but somewhat congested.

The liver comes within 1½ cm. of the costal arch at the right 10th rib and weighs 1470 grams. It is dark in color, the left lobe being darker than the right. It cuts with normal resistance. The markings are fairly distinct and much blood exudes from the cut surface.

The pancreas shows no change.

The stomach is distended and somewhat congested; otherwise normal.

The brain shows no external change except hyperemia of the pia. It was placed in 10 per cent formalin.

The spinal cord shows great redness of the gray matter at all levels.

The tissues of the back are edematous.

Anatomic Diagnosis.—Hemorrhagic poliomyelitis. Purulent cystitis. Hyperemia of all viscera. Pulmonary edema and hypostatic congestion. Localized fibrous pleuritis and fibrinous pericarditis. Slight sclerosis of the aorta and the mitral valves. Edema of the back. Bed-sores over the sacrum and left scapula. Catheter in the urethra.

BACTERIOLOGICAL EXAMINATION.

The blood.—Dr. A. M. Stober, resident pathologist of the hospital, examined the heart's blood, which was collected in pipettes, allowed to coagulate, and placed in the incubator. Small beads appeared in the serum after 24 hours. The growth was found to consist of encapsulated diplococci, arranged in chains. The elements were spherical at first, later somewhat lance-shaped. They stain by Gram's method.

Agar slants.—Slight grayish streaks.

Blood agar.—Growth more luxuriant. Kept alive for three months.

Glucose agar.—Gas produced in 24 hours.

Gelatin stab.—Good growth along the entire length. No liquefaction.

Potato.—Grayish-white, elevated growth.

Litmus milk.—Reduced in 24 hours. Coagulated and pink in 72 hours.

Broth.—A white, flocculent precipitate in slightly turbid fluid forms in 24–48 hours.

Seven days after the autopsy the growth of one blood-agar tube suspended in four c.c. of broth was injected subcutaneously into a rabbit. The animal was very ill for three days, but ultimately recovered. The growths on four agar slants were subsequently injected intraperitoneally, but caused no marked reaction. Ten days later one c.c. of a broth culture was injected subdurally through a trephine opening without reaction, and later two c.c. into the spinal subdural space without reaction.

The rest of the bacteriologic work was done in the laboratory of Rush Medical Laboratory by Dr. J. A. MacGregor and Mr. E. L. Mattox.

Cord and sciatic nerve.—Emulsions were made in salt solution and various media inoculated. Only the colon bacillus was obtained.

Liver.—Two kinds of colonies developed. One was positively identified as the pneumococcus, the other as the Staphylococcus cereus flavus. The pneumococcus was inoculated into a rabbit, which did not die, but the organism was recovered in cultures from its blood and then killed a second rabbit. This organism was thoroughly studied by Dr. Rosenow, who at that time was making his investigations on pneumonia, and he identified it positively as a pneumococcus.

Peritoneal fluid.—The pneumococcus and Bacillus coli communis.

Spleen.—The Bacillus coli communis.

HISTOLOGIC EXAMINATION.

The spinal cord; cervical region.—Hematoxylin and eosin. The meshes of the pia, particularly at the mouth of the ventral fissure, contain small, perivascular collections of small, mononuclear round cells. The collections, however, are too scant to cause any appreciable thickening in the membrane. The chief change in the white matter consists in the presence of small collections of round cells about the larger vessels. These cells have the size, shape, and staining qualities of small lymphocytes. The vessels are densely packed with red blood cells, their walls unchanged. In places, particularly in front of the ventral commissure on both sides and along the ventral and lateral borders of the ventral horns, there seems to be a slight edema, the texture being loose and an almost homogeneous grayish-blue material present. The dorsal columns appear more compact.

The gray matter shows by far the most pronounced changes. It appears dense and is chiefly made up of dilated vessels engorged with blood and surrounded by extravasated blood, and of various forms of inflammatory cells. Some of the smaller vessels contain many polymorphonuclear leucocytes. The few remaining ganglion cells are so inconspicuous in the midst of the inflammatory tissue as to be easily overlooked on a hasty examination. All parts of the ventral horns are about equally affected, while in the dorsal horns the inflammatory changes are limited to the immediate neighborhood of the vessels. According to their morphology the inflammatory cells may be classified as follows: (1) Cells of the lymphocyte type; numerous. (2) Polymorphonuclear leucocytes; few. (3) Cells slightly larger than small lymphocytes and with less chromatin in their nuclei; only a narrow rim of cytoplasm. (4) Cells with nuclei like the preceding class, and large, round, polygonal, pyramidal, or irregular, granular, unstained, and in places vacuolated, cytoplasm. Frequently distinct small nuclei are seen. These cells are very numerous and are plainly of the type known as "fat granule cells," as they are blackened by the osmic acid in Marchi preparations. (5) Typical plasma cells near the vessels. (6) Oblong cells with almost homogeneous, slightly stained cytoplasm. The nucleus consists of large, dark chromatin granules; no visible nuclear membrane. These cells are seen near the vessels. (7) Cells with nuclei like class 5, but with large, irregular cytoplasm. (8) Cells without distinct cytoplasm. A rim of granules the size of those usually seen in plasma cells occupy the periphery.

The last three classes probably owe their peculiarities to various forms of regressive changes.

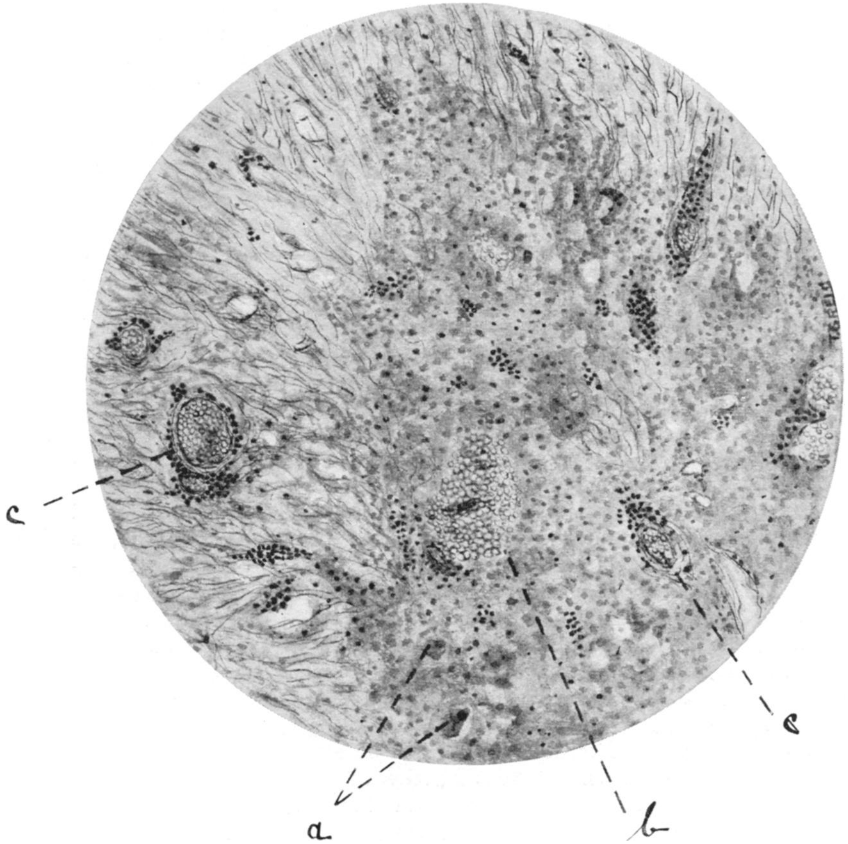

FIG. 1.—Ventral horn from man. Hematoxylin and eosin. Low power.
a. Shadow of ganglion cells.
b. Hemorrhage.
c. Perivascular infiltrations.

Nissl's method (after alcohol hardening).—Only a few ganglion cells are seen in the ventral horns, all showing changes. In the dorsal horns the ganglion cells appear spindle-shaped, with distinct nuclei and nucleoli, and finely granular cytoplasm. On account of the small number of ventral horn cells present and the variety of changes found in them a general description is impossible. A more trustworthy idea of them may be conveyed by simply describing most of the individual cells encountered in the study of a few Nissl preparations with the oil immersion lens.

Ventral group: (*a*) A cell pyramidal in shape, with a centrally placed nucleus with intact membrane and central nucleolus. In the cytoplasm are large, peripheral heaps of tigroid, no normal Nissl bodies. One process is visible for a long distance. (*b*) Two smaller cells with ragged outlines and devoid of nuclei, with irregular, broken up tigroid masses. (*c*) A rather large, rounded cell, also with ragged outline and encroached on by small, round cells. The cytoplasm contains small, irregular granules. The nucleus is distinct, with a nucleolus, but almost devoid of chromatin. (*d*) A narrow, bulb-shaped cell. Toward the base, the cytoplasm is deep blue, with extremely fine granules. The nuclear membrane is indistinct, the nucleolus distinct. (*e*) An irregularly oblong cell with homogeneous, unstained cytoplasm, and a greatly swollen, finely granular nucleus; no nucleolus.

Ventromesial group: (*a*) A cell resembling *c* in preceding group. (*b*) A large one with deeply stained cytoplasm containing fine and coarse granules, but no typical Nissl bodies. The nucleus is well marked but without distinct membrane. (*c*) A sky-blue homogeneous shadow with a vacuole. (*d*) A greatly shriveled shadow, almost unstained, lying in a wide space. It contains refractile droplets in large numbers. (*e*) Two similar shadows, destruction even more advanced. (*f*) A multipolar cell with distinct outlines. Nucleolus distinct, nucleus not plainly outlined. The cytoplasm presents a fine, spongelike network, with minute circular and oval vacuoles. It is encroached on by round cells. (*g*) An elongated multipolar cell with process visible across two oil immersion fields. No nucleus. A few Nissl bodies are seen in the processes. The cell body possesses irregular tigroid débris only. (*h*) Elongated cell with distinct outlines and distinct nucleus. One process is very long. The cytoplasm is filled with fine blue granules, and from one nuclear pole two rows of larger granules proceed, diverging, to pass one along each side of the cell, then converging toward the beginning of the long process, where they end. (*i*) A long, pyramidal cell with plain nucleus and nucleolus. The cytoplasm is disintegrating and encroached on by round (glia?) cells. A process springing from the apex is visible across an entire oil immersion field. Laterally one comparatively normal multipolar cell is seen, showing some tigrolysis.

A large number of specimens stained with the Gram-Weigert method were carefully examined, but failed to show any organisms.

A few bacilli are seen in Loeffler's methylene blue sections.

No degeneration can be made out in Weigert-Pal sections.

Thoracic region.—The changes are similar to those in the cervical region. The vessels are dilated and engorged with blood. There are large, perivascular collections of round cells in both the gray and white matter. Many vessels, particularly the small ones in the gray matter, contain numerous polymorphonuclear leucocytes. There are no large ganglion cells in the ventral horns, which are occupied mainly by fat granule cells. The latter cells constitute the bulk of the inflammatory cells except close to vessels, where cells of the lymphocyte type predominate. The ganglion cells of

Clarke's columns show no change except a slight tigrolysis. A few thick bacilli are seen in preparations stained by Loeffler's blue. No organisms in Gram-Weigert specimens. There is some diffuse blackening in Marchi preparations. No change in the white tracts can be made out in Weigert-Pal specimens.

Lumbar region.—The picture is similar to that seen higher up. The hemorrhage and round-celled infiltration are most marked in the gray matter, but there are also numerous collections of round cells about the vessels of the white matter, particularly in the lateral columns. The ventral horns are here also mainly made up of inflammatory cells. The few ganglion cells seen are greatly altered, the changes being like those described in the cervical region. Only 17 ganglion cells are seen in one ventral horn in a Nissl preparation 10 microns thick. There is only a diffuse blackening in Marchi's specimens. In Weigert-Pal specimens the lateral columns appear lightened. There are two symmetrically placed lighter areas, both near the periphery, one situated laterally to the most external portion of the ventral horn, the other opposite the dorsal commissure. There also appears to be some loss of fibers in the ventral roots. Here also, Gram-Weigert specimens failed to show organisms.

The *spinal dura* shows no change.

The *spinal ganglia* from the three regions of the cord were fixed in Zenker's fluid and stained by the hematoxylin-eosin, Nissl and Gram-Weigert methods. The ganglion cells only show a moderate tigrolysis involving the whole or central part of the cytoplasm. The nuclei are centrally placed. The usual amount of pigment is present. There are no inflammatory changes in the ganglia themselves, but the adipose tissue outside the thoracic ganglion examined, shows hemorrhage and a large inflammatory focus. The cells are mostly of the small mononuclear type, but there are also many polymorphonuclear cells, some plasma cells, and a few large multinuclear cells (probably endothelial).

The brain.—Pieces from the frontal and motor regions were hardened in alcohol and stained by the hematoxylin-eosin and Nissl methods. Other pieces hardened in formalin were stained with neutral red. There are no definite and constant changes in the ganglion cells. There appears to be some increase in small glia cells. There is no Marchi degeneration in specimens from the left motor cortex, crus cerebri, thalamus, and from the medulla oblongata. Hematoxylin-eosin specimens of the latter show dense collections of small mononuclear round cells about the vessels in every part of the cross sections. There are no inflammatory areas except in the immediate neighborhood of the vessels.

The nerves.—Portions of both vagi, ulnar, anterior crural, and sciatic nerves were treated by the Marchi method. One of the vagi shows no degeneration, the other a moderate degree. The ulnar and anterior crural nerves are distinctly degenerated, the sciatic nerves practically unaffected. The degeneration seems to be the only lesion, as no signs of neuritis can be detected in sections from the anterior crural and sciatic nerves stained by hematoxylin and eosin.

The *thyroid* is hyperemic. The follicles are distended with colloid. Small interstitial hemorrhages are seen.

The *lung* shows marked hyperemia. Many alveoli are filled with blood. There is an increased number of leucocytes in the blood-vessels.

There is a narrow hemorrhagic zone beneath the capsule of the *spleen.* The pulp is hyperemic. Polymorphonuclear cells are numerous both in the Malpighian bodies and pulp. No organisms could be demonstrated in Gram-Weigert preparations.

Small subcapsular hemorrhages are present in the *liver.* Light brown pigment granules are seen in the liver cells of the central parts of the lobules. Gram-Weigert specimens are negative as to microorganisms.

There are slight subcapsular hemorrhages in the *kidneys.* The cells of the convoluted tubules are swollen, their nuclei as a rule intact.

Both the bacteriologic and histologic findings in the preceding case plainly point to a general bacterial invasion with a special localization of the action of the toxic substances in the cord. There can be no doubt as to the presence of pneumococci in the peritoneal fluid and liver. Whether the organism from the blood was another diplococcus or its peculiar behavior on culture media was due to admixture with other organisms must be left undecided. In considering the latter alternative it must be borne in mind that the colon bacillus may assume a diplococcus form (Adami). Assuming the admixture of colon bacilli with pneumococci the appearance of the cultures from the blood may be accounted for. It must also be considered proved that the ascending paralysis in this case was due to primary changes in the gray matter of the cord, and that the degeneration encountered in the motor nerves was a secondary one, as no neuritis could be demonstrated. Only the large nerve trunks were examined. The claim might be made that there had been a primary neuritis of the end ramifications of the nerves, the infective agent then passing rapidly along the nerve trunk to the cord. The elaborate experiments of Homén and Laitinen,[1] who injected streptococci and streptococcic filtrate into peripheral nerves, have demonstrated the rapid migration of such agencies along the lymph channels of the nerve trunks to the cord where severe changes may be set up. However, in their experiments changes were produced in the nerve trunks in the shape of leucocytic emigration, proliferation of the nuclei and of the endoneural cells, etc. In this case the extensive changes in the cord, coupled with the slight simple degeneration of the nerves, would at once make it appear at least far fetched to consider it one of primary neuritis, and in view of the short duration, the absence of inflammatory changes in the nerve trunks forces the conclusion that the changes in the nervous system first took place in the cord.

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[1] *Ziegl. Beitr.*, 1899, 25, p. 1.

In connection with changes in the cord by bacteria and their products, the writer is fortunate enough to be able to relate a rather definite experiment. In a fatal case of carbuncle of the lip a thorough bacteriologic examination by Mr. E. T. Hanley demonstrated the Staphylococcus pyogenes albus as the sole organism present. Cultures were injected subcutaneously into a rabbit. Nodules developed in the vicinity of the point of inoculation but the animal did not become ill until a further inoculation into the blood had been made. About a month after the first inoculation the animal's hind-legs became paralyzed. The following day the forelegs were also paralyzed. It died on the third day. The autopsy revealed a greatly distended urinary bladder. There were no metastatic abscesses.

Pieces of the cord were hardened in alcohol and stained by the Nissl and hematoxylin-eosin methods. No inflammatory changes are present at any level. Nissl specimens from the cervical region show a pronounced tigrolysis in the ventral horn cells. The normal arrangement of the tigroid is nowhere seen. It is broken up into fine particles which again may be clustered together to form larger lumps. In many instances the cell outlines are ragged, the nuclear outlines also destroyed while the nucleoli generally persist. The cells of the dorsal horns are much better preserved, their nuclei being unaffected. Similar cell changes are seen in the thoracic region, while they are less pronounced in the lumbar region. Here there is also marked tigrolysis, but the nuclear and cellular outlines are generally preserved. Marchi specimens from the cervical region show slight blackening on either side of the ventral median fissure and very slight of the lateral columns of both sides. In the lumbar region there is a slight diffuse blackening. Marchi specimens from the right and left sciatic nerves show considerable blackening in both, while no inflammatory processes are seen in hematoxylin-

PLATE 20.

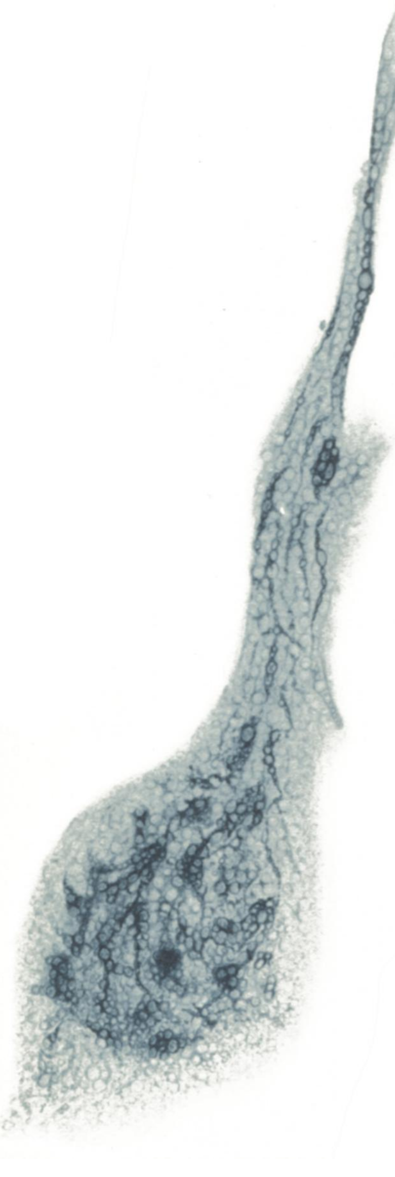

Fig. 1.

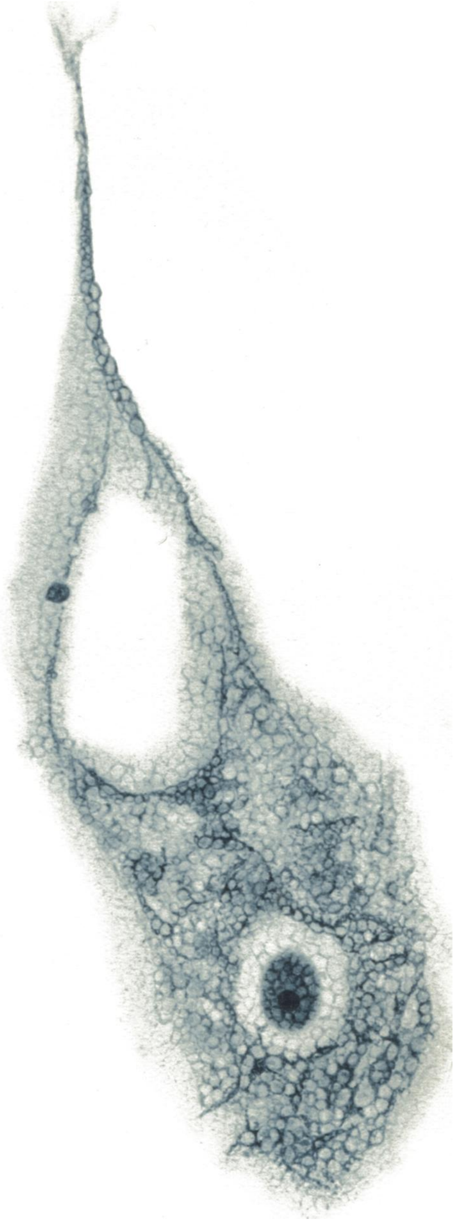

Fig. 2.

eosin specimens. Sections from the cortex of the brain fixed in formalin and stained by neutral red show no definite cell changes. There is no blackening in Marchi specimens from the hemispheres.

DESCRIPTION OF PLATE 20.

FIGS. 1 and 2.—Ventral horn cells from rabbit. Nissl's stain. Oil immersion 1/12 Zeiss.